

# PATENT ABSTRACTS OF JAPAN

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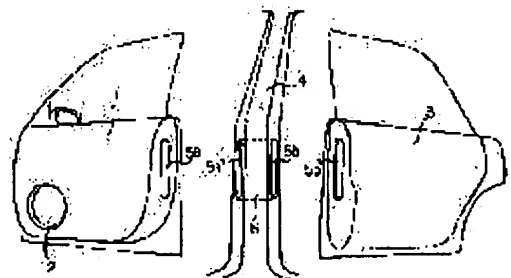
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## (54) VEHICULAR SPEAKER SYSTEM

### (57)Abstract:

PURPOSE: To increase the capacity of a speaker cabinet (the back cavity of a speaker) and improve a low sound regenerative power.

CONSTITUTION: In a vehicular speaker system for installing a speaker 2 on at least one car room side wall surface of the front door 1 or rear door 3 of an automobile and for using at least one part of the inner space of a door as a cabinet, a first opening part 5a is installed on the side part in the rear door 3 side of the front door 1 and also a second opening part 5b is installed on the side part in the front door 1 side of the rear door 3 and the first opening part 5a is communicated with the second opening part 5b mutually by closing the front door 1 and the rear door 3.



## LEGAL STATUS

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] In case this invention performs audio playback of a car stereo etc. in the vehicle interior of a room of an automobile, it relates to the loudspeaker system for cars which reproduces sufficient heavy bass.

[0002]

[Description of the Prior Art] In order to reproduce bass in a loudspeaker system, the volume of a cabinet influences greatly. This principle is explained based on the loudspeaker system [beaming] which is well-known reference, Takeo Yamamoto work, a radio technical company, and the publication of the "Chapter 8 cabinet" of the 1977 issue.

[0003] Lowest-resonance-frequency  $f_0'$  in the case of using a loudspeaker alone is [0004] by the equivalent stiffness  $S_0$  (the edge of a loudspeaker, hardness of a damper) and equivalent mass (sum of the mass  $m_d$  of a diaphragm, and the additional mass  $m_{ad}$  of one side of a diaphragm) of a loudspeaker.

[Equation 1]

$$f_0' = \frac{1}{2\pi} \sqrt{\frac{S_0}{m_d + m_{ad}}} \quad (\text{Hz}) \cdots (1)$$

[0005] It is come out and expressed. Since the sound which comes out from after differs from the sound in which the acoustic wave emitted from a loudspeaker appears from before a diaphragm in 180 degrees of phases, even if it uses a loudspeaker alone, both sounds negate each other, and a sound becomes small. In order to prevent this, the property of loudspeaker original can be demonstrated by forming the baffle which intercepts loudspeaker order. The case of being big is ideal for infinity, and this baffle is the lowest resonance frequency  $f_0$  at this time. Equivalent stiffness  $S_0$  of a loudspeaker By the equivalent mass (sum with additional-mass  $2m_{ad}$  of the mass  $m_d$  of a diaphragm, and both sides of a diaphragm), it is [0006].

[Equation 2]

$$f_0 = \frac{1}{2\pi} \sqrt{\frac{S_0}{m_d + 2m_{ad}}} \quad (\text{Hz}) \cdots (2)$$

[0007] It is come out and expressed. However, it is impossible to attach a loudspeaker in the infinite baffle in fact, and it is usually used, attaching in a sealing form cabinet etc. As shown in drawing 5, the loudspeaker 61 for front seats of an automobile is attached in a front door 60 also for the conventional loudspeaker system for cars, and this front door works as a sealing form cabinet.

[0008] Volume  $V_c$  Lowest-resonance-frequency  $f_{0c}$  at the time of attaching a loudspeaker in a sealing form cabinet is the equivalent stiffness  $S_0$  of a loudspeaker. Equivalent stiffness  $S_c$  of a cabinet What was added, and mass  $m_d$  of a diaphragm It is [0009] by the equivalent mass to which the configuration of a cabinet and additional-mass  $2B m_{ad}$  with the rate  $B$  of mass addition decided by magnitude were

added.

[Equation 3]

$$f_{0c} = \frac{1}{2\pi} \sqrt{\frac{S_0 + S_c}{m_d + 2Bm_{ad}}} \quad (\text{Hz}) \quad \dots (3)$$

[0010] It is come out and expressed. However, equivalent stiffness  $S_c$  of a cabinet The radius  $a$  and volume  $V_c$  of the part which is vibrating to the consistency of air, the acoustic velocity in air, and the actual condition of a diaphragm It takes into consideration and is [0011].

[Equation 4]

$$S_c = \frac{1.4 \times 10^5 \cdot a^4}{V_c} \quad (\text{N/m}) \quad \dots (4)$$

[0012] It is come out and expressed. Lowest resonance frequency  $f_0$  of lowest-resonance-frequency  $f_{0c}$  of this sealing form cabinet, and said infinite baffle A ratio is [0013].

[Equation 5]

$$\frac{f_{0c}}{f_0} = \sqrt{1 + \frac{S_c}{S_0} \times \frac{m_d + 2m_{ad}}{m_d + 2Bm_{ad}}} \quad \dots (5)$$

[0014] A next door and in the case of  $B=1$ , it is [0015].

[Equation 6]

$$\frac{f_{0c}}{f_0} = \sqrt{1 + \frac{S_c}{S_0}} \quad \dots (6)$$

[0016] It becomes. It sets in a number (5) and a number (6), and is  $S_c / S_0$ . Since it becomes a positive number, it is shown that  $f_{0c}$  becomes surely larger than  $f_0$ , and a bass playback limitation becomes high. Here, it is  $f_{0c}$  from a number (6)  $f_0$  In order to bring close to a value, it is the stiffness  $S_c$  of a cabinet. Since what is necessary is just to make it small, it is the capacity  $V_c$  of a number (4). What is necessary will be just to enlarge as much as possible.

[0017]

[Problem(s) to be Solved by the Invention] As mentioned above, the volume of a cabinet is greatly related to bass playback in the loudspeaker system attached in the front door of an automobile. Usually, the volume of a front door was 10l. - 20l., and was not necessarily sufficient capacity to reproduce bass.

[0018] This invention is made in view of the above-mentioned trouble, the capacity (back cavity of a loudspeaker) of a loudspeaker cabinet is increased, and it aims at aiming at the improvement of the bass ability to regenerate.

[0019]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention attaches a loudspeaker in the front door of an automobile, or at least one vehicle room side-attachment-wall side of a rear door. In the loudspeaker system for cars which uses a part of building envelope [ at least ] of this door as a cabinet, while preparing the 1st opening in said rear door side flank of said front door It is characterized by this 1st opening and this 2nd opening being mutually open for free passage by preparing the 2nd opening in said front door side flank of said rear door, and closing said front door and said rear door.

[0020] Moreover, it is characterized by preparing the pipe duct which carries out opening towards the vehicle interior of a room in either said front door or a rear door. Moreover, it is characterized by preparing said 3rd opening and the 4th opening which counters at said rear door by preparing the 3rd opening in a flank still more opposite to said 2nd opening, and closing said rear door in a trunk room.

[0021] Moreover, a loudspeaker is attached in one [ at least ] vehicle room side-attachment-wall side of the front door of the pair of an automobile, and in the loudspeaker system for cars which uses a part of building envelope [ at least ] of this door as a cabinet, while preparing opening in the lower part of the

front door of said pair, respectively, when the front door of said pair is closed, it is characterized by preparing the connection pipe which connects said double door regio oralis.

[0022]

[Function] If this invention is followed, the capacity of a cabinet will be made to increase by making the building envelope of a rear door connect with a front door through opening. Moreover, the capacity of a cabinet is made to increase by making the building envelope of the thing which makes the building envelope of a trunk connect with the thing which made the building envelope of a rear door connect with said front door as an option further, and the front door of a pair connect.

[0023] Therefore, it becomes possible to aim at improvement in the bass ability to regenerate at the same loudspeaker as the former.

[0024]

[Example] Hereafter, the example of this invention is explained using a drawing. Drawing 1 is the perspective view of the door of the automobile in which the 1st example of this invention is shown. one -- a front door -- two -- a front door -- one -- a vehicle -- a room -- a side attachment wall -- a field -- attaching -- having had -- a loudspeaker -- three -- a rear door -- four -- a center pillar -- five -- a -- a front door -- one -- a center pillar -- a side -- a flank -- preparing -- having had -- opening -- five -- a -- ' - a center pillar -- four -- a front door -- a side -- a flank -- preparing -- having had -- opening -- five -- b -- a rear door -- three -- a center pillar -- a side -- a flank -- preparing -- having had -- opening -- five -- b -- ' -- a center pillar -- four -- a rear door -- a side -- a flank -- preparing -- having had -- opening -- it is . It is prepared in the location which counters when rubber packing each opening 5a, 5a', and for carrying out sealing maintenance of the joint at 5b and 5b' etc. is performed and opening 5a and opening 5a' and opening 5b and opening 5b' close a front door 1 and a rear door 3, respectively. Moreover, opening 5a' and opening 5b' are connected with the pipe 6 tubed within a center pillar 4.

[0025] If a front door 1 is closed, opening 5a of a front door 1 and opening 5a' of the center pillar 4 will be joined, and if a rear door 3 is closed, opening 5b of a rear door 3 and opening 5b' of a center pillar 4 will be joined. Therefore, where a front door 1 and a rear door 3 are closed, each joint is joined where sealing maintenance is carried out with rubber packing etc., and the building envelope of a front door 1 and the building envelope of a rear door 3 are connected with the tubed pipe 6.

[0026] Thus, since cabinet capacity (back cavity) of a loudspeaker 2 can be made into the twice as many conventional profile as this by connecting the building envelope of a front door 1, and the building envelope of a rear door 3, it becomes possible to make lowest-resonance-frequency  $f_{0c}$  small, and improvement in the bass ability to regenerate can be aimed at by the same loudspeaker as the former. Drawing 2 is the perspective view of the door of the automobile in which the 2nd example of this invention is shown, and is made into the cabinet structure of a bus reflex form by establishing a port 7 in the rear door 3 in said 1st example. In addition, the same sign was given to the thing equivalent to drawing 1 .

[0027] It is [0028], when lowest resonance frequency of the cabinet of this bus reflex form is set to  $f_{0b}$  and it compares with lowest-resonance-frequency  $f_{0c}$  of a sealing form cabinet.

[Equation 7]

$$f_{0c} = \sqrt{3 f_{0b} \dots (7)}$$

[0029] It is indicated by the well-known reference stated with the conventional technique, and if becoming attaches a loudspeaker in a bus reflex form cabinet, it will become possible [ extending a bass playback band to the root 1 (1/31/2)/3 ] compared with the case where it attaches in the sealing form cabinet of this volume. Therefore, according to the 2nd example of this invention, that of a port 7 can extend a bass playback band to the root 1 (1/31/2)/3 rather than said 1st example by \*\*\*\*\*, and it becomes possible to improve the bass ability to regenerate further.

[0030] Drawing 3 is the partial cross-section perspective view seen from the rear side of the automobile in which the 3rd example of this invention is shown. Opening by which a rear pillar and 10a prepared a rear door and 11 in the trunk, and 3 prepared 12 in the flank by the side of the rear pillar 12 of a rear

door 3, opening which prepared 10a' in the flank by the side of the rear door of the rear pillar 12, opening which prepared 10b in the trunk, opening which prepared 10b' in the flank by the side of the trunk of a rear pillar, and 13 are tubed pipes which connect opening 10a' and 10b' within a rear pillar. [0031] Opening 10b of a trunk and opening 10b' by the side of the trunk of a rear pillar are joined beforehand, where sealing maintenance of opening 10a of a rear door 3 and opening 10a' of the rear pillar 12 is carried out with rubber packing etc. by closing a rear door 3, it is joined, and the building envelope of a trunk 11 and the building envelope of a rear door 3 are connected through a tubed pipe or a tubed structural part 13.

[0032] In addition, although not illustrated, like the 1st example explained by drawing 1 also in this example, a loudspeaker 2 is attached in the vehicle room side-attachment-wall side of a front door 1, and where a front door 1 and a rear door 3 are closed and sealing maintenance of the building envelope of a front door 1 and the building envelope of a rear door 3 is carried out through each opening, it is connected. Thus, since the cabinet capacity of a loudspeaker 2 becomes what added the building envelope of a trunk 11 to the building envelope of a front door 1, and the building envelope of a rear door 3 further according to the 3rd example of this invention based on drawing 3, the cabinet capacity of a loudspeaker 2 can increase and the bass ability to regenerate can be improved further.

[0033] Moreover, according to this structure, the conventional trunk is applicable also to the loudspeaker system which consists of a diameter loudspeaker of macrostomia attached in the rear deck which is used as a cabinet, and which is not illustrated, woofer, etc. Furthermore, by establishing a port in the rear deck from a trunk, and sending the tooth-back sound of a loudspeaker to the vehicle interior of a room, bass playback is raised, loudspeakers for bass playback, such as woofer, are omitted, the quantity of a loudspeaker is reduced as a whole, and it becomes possible to aim at lightweight-izing and a cost cut.

[0034] Drawing 4 is the partial cross-section perspective view of the door of the automobile in which the 4th example of this invention is shown. The loudspeaker by which 20 was attached in one front door and 21 was attached in the vehicle room side-attachment-wall side of one front door 20, The loudspeaker by which 30 was attached in the front door of another side, and 31 was attached in the vehicle room side-attachment-wall side of the front door 30 of another side, A connection pipe for 40 to connect the building envelope of one front door 20, and the building envelope of the front door 30 of another side, 50 -- a -- one side -- a front door -- 20 -- the lower part -- having prepared -- opening -- 50 -- a -- ' -- connection -- a pipe -- 40 -- one side -- a front door -- 30 -- a side -- opening -- 50 -- b -- another side -- a front door -- 30 -- the lower part -- having prepared -- opening -- 50 -- b -- ' -- connection -- a pipe -- 40 -- another side -- a front door -- 30 -- a side -- having prepared -- opening -- it is .

[0035] both -- a front door -- 20 -- 30 -- closing -- if -- each -- a front door -- opening -- 50 -- a -- 50 -- b -- not illustrating -- a seat -- the bottom -- etc. -- having prepared -- connection -- a pipe -- 40 -- opening -- 50 -- a -- ' -- opening -- 50 -- b -- ' -- respectively -- rubber packing -- etc. -- sealing -- maintenance -- carrying out -- having had -- a condition -- joining -- having -- both -- a front door -- 20 -- 30 -- a building envelope -- connecting -- having . Thus, since it becomes what applied the capacity of the connection pipe which connects these two front doors with the capacity of two front doors for the cabinet capacity of a loudspeaker according to the 4th example of this invention, the cabinet capacity as the whole loudspeaker can increase and the bass ability to regenerate can be improved. Moreover, the connection pipe 40 functions also as components of an automobile on the strength, and serves also as reinforcement components to the external force from width.

[0036]

[Effect of the Invention] since not only the conventional front door but the front door of a rear door and a trunk, and another side uses the cabinet capacity of the loudspeaker in an automobile as a cabinet capacity as mentioned above according to this invention, by the same loudspeaker as the former, the bass ability to regenerate can be boiled markedly and can be raised.

[0037] Moreover, loudspeakers for bass playback, such as woofer, become unnecessary by raising the bass ability to regenerate, and reduction of the quantity of the loudspeaker as the whole, lightweight-izing, and a cost cut are attained.

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[Translation done.]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the perspective view of the door of the automobile in which the 1st example of this invention is shown.

[Drawing 2] It is the perspective view of the door of the automobile in which the 2nd example of this invention is shown.

[Drawing 3] It is the partial cross-section perspective view seen from the rear side of the automobile in which the 3rd example of this invention is shown.

[Drawing 4] It is the partial cross-section perspective view showing the front door of the automobile in which the 4th example of this invention is shown.

[Drawing 5] It is drawing showing the appearance of the conventional front door.

[Description of Notations]

1 ... Front door

2 ... Loudspeaker

3 ... Rear door

4 ... Center pillar

5a, 5a', 5b, 5b' ... Opening

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[Translation done.]

## \* NOTICES \*

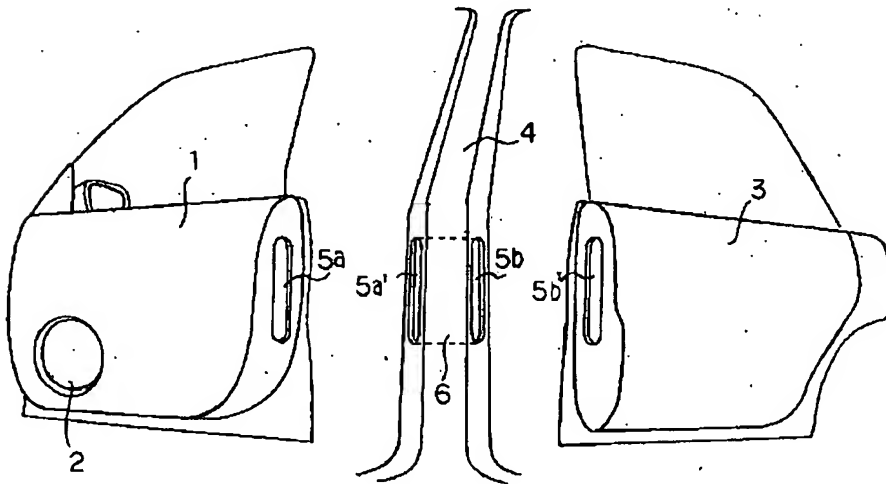
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## DRAWINGS

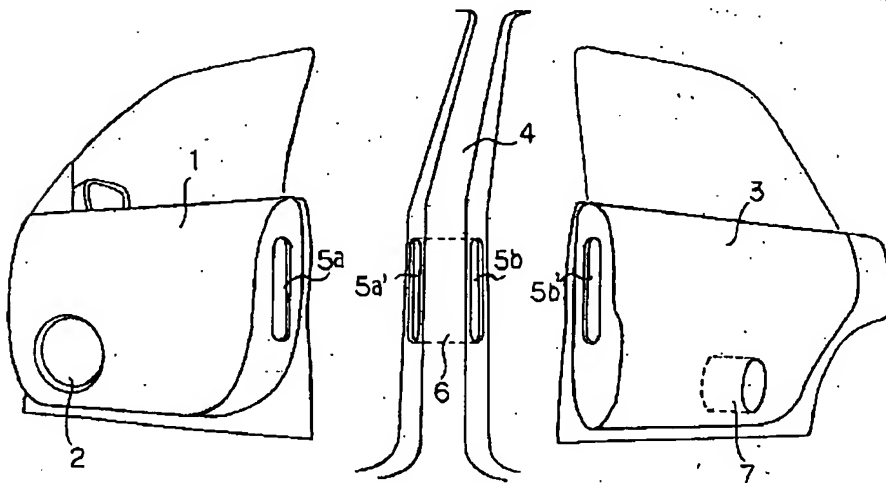
[Drawing 1]

本発明の第1の実施例を示す自動車のドアの斜視図



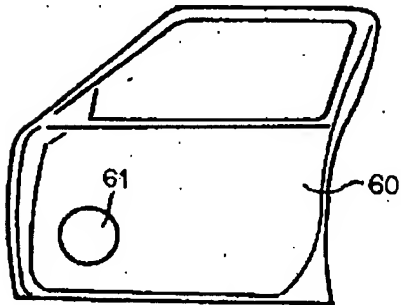
[Drawing 2]

本発明の第2の実施例を示す自動車のドアの斜視図



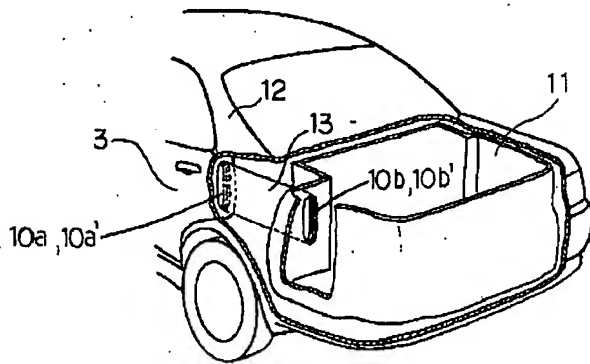
[Drawing 5]

従来のフロントドアの外観を示す図



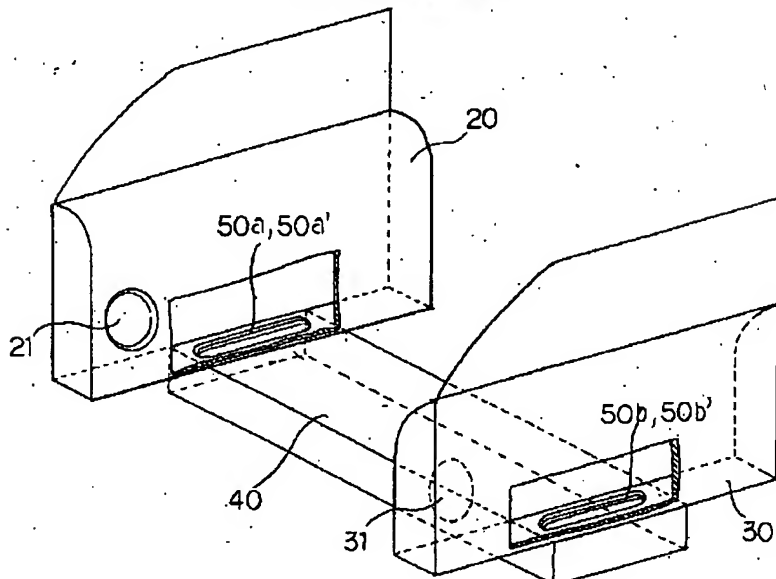
[Drawing 3]

本発明の第3の実施例を示す自動車のリア側から見た部分断面斜視図



[Drawing 4]

本発明の第4の実施例を示す自動車のフロントドアを示す部分断面斜視図



[Translation done.]